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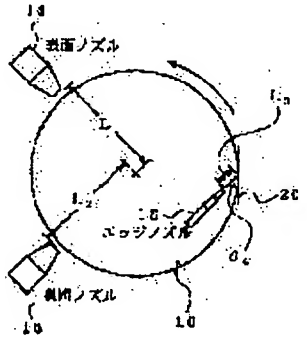
(54) METHOD AND APPARATUS FOR ETCHING REMOVAL AS WELL AS METHOD AND APPARATUS FOR CLEANING

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent a treating liquid from flowing toward the central part on the surface of a wafer, by a method wherein a rear nozzle which holds and turns the wafer and which spouts a liquid to the center on the rear of the wafer is provided, and a surface nozzle which spouts a liquid to the center to the surface of the wafer is provided.

SOLUTION: A wafer holding mechanism is a holding mechanism of a roller chuck system, and it comprises four wafer rollers which are connected to shafts. A surface nozzle 14 spouts a liquid to the center on the surface of a wafer, a rear nozzle 16 spouts a liquid to the center on the rear of the wafer, and an edge nozzle spouts a liquid to the periphery on the surface of the wafer. The liquid which are spouted from the surface nozzle 14 and the rear nozzle 16 are spread toward the periphery of the wafer due to a centrifugal force by the rotation of the wafer. As the spouting state of the liquids from the surface nozzle 14 and the rear nozzle 16, the liquid may be supplied to the center of the wafer. As a result, the liquid may be spouted in a beam shape, or the liquid may be spouted in a spraying state.

(A)



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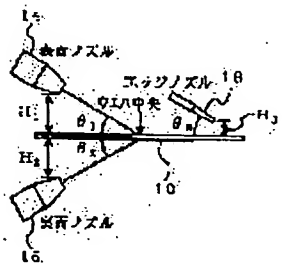

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the washing approach and equipment which are further used in the production process of a semiconductor device about the etching removal approach and equipment which are used in the production process of a semiconductor device.
[0002]
[Description of the Prior Art] unnecessary, when producing a semiconductor device on a wafer -- it is -- it is -- an ingredient [**** / un-] is removed by etching, or, generally washing the contamination which adhered on the wafer or the device is performed.
[0003] In such removal and washing, it may be required that the ingredient [**** / un-] which exists in the circumference of surface of a wafer, an end face, the circumference of a rear face, and a rear face especially should be removed, or a contamination should be removed. Here, an end face points out the side face of the periphery of a wafer, the circumference of surface points out the field between a device formation field and an end face on a wafer front face, and the circumference of a rear face points out the field in which the metal membrane [**** / un-] was formed in respect of the wafer.
[0004] For example, Cu wiring is SiO2, when it replaces with aluminum as a wiring material and Cu with high conductivity is used. After forming a slot on the film and carrying out Cu membrane formation by electric-field plating, it is formed of chemical machinery polish (CMP) in many cases. This is the Cu wiring formation approach currently called the so-called DAMASHIN method.
[0005] Specifically, formation of such Cu wiring is SiO2. Spatter membrane formation of the barrier metal (for example, Ta, TaN, etc.) for preventing diffusion of Cu is carried out, a slot is formed in the film, spatter membrane formation of the seed Cu is carried out continuously, and Cu is formed by electrolytic plating. Electrolytic plating prepares the ring surrounding a device formation field on a wafer front face, pours in plating liquid inside a ring and is performed inside. However, if plating liquid leaks from a ring, Cu will be formed out of a ring (i.e., the circumference of surface of a wafer). Such Cu film is an ingredient [**** / un-]. Because, Cu and SiO2 which were plated It is because adhesion is low, so film peeling produces Cu film around wafer surface with membranous stress etc. in a subsequent membrane formation process etc. and contamination of Rhine is produced. Therefore, Cu film formed around such wafer surface must be removed.
[0006] Furthermore, a wafer is polluted with Cu which is polish waste after CMP. Such Cu is Si substrate and SiO2 by subsequent heat-treatment. If the inside of the film is diffused and a device field is arrived at, it will become the cause which has a bad influence on the engine performance of a semiconductor device. Cu adhering to the circumference of surface of Si substrate which is a wafer, an end face, and a rear face cannot separate easily, therefore must be removed by washing.
[0007] When the size of the wafer used for the above process is 8 inches, the distance from the edge of a device formation field to a wafer end face is about 5mm. It is SiO2 in order to enlarge a device formation field. It is desirable to bring the film close even to 1.5-2mm from a wafer end face further, and to form it. In such a case, if Seed Cu is formed by the whole surface spatter, Seed Cu will turn to an end face from the circumference of surface of a wafer, and will be formed even around a rear face. At the time of the electrolytic plating of degree process, plating liquid leaks from a ring, it turns from the circumference of surface to an end face, and Cu film is formed on Seed Cu.
[0008] Since this Cu film is formed after Seed Cu, there is no fear of peeling, but if the end face of a wafer adheres to Cu, this Cu will adhere to the carrier and robot arm of a wafer, and will produce cross contamination by the conveyance system. Therefore, it is required that Cu adhering to a wafer end face should remove.
[0009] Since a surrounding distance outside a device formation field is very small as it was called 1.5-2mm, this removal must have a good controllability. Also in case this washes the contamination Cu adhering to the circumference of surface of a wafer, an end face, and a rear face after CMP, it is the same.
[0010] In order to remove or wash Cu film [**** / as mentioned above / the circumference of surface of a wafer, an

end face, and a rear face / un-], and Contamination Cu, there are the following conventional techniques.
[0011] Drawing 25 shows an example of the conventional technique. With this conventional technique, the protective coat which has FPM (mixed liquor of HF/H2 O2 / H2 O) resistance in the device formation field of a wafer 10 is formed, the whole wafer is immersed into an etching reagent FPM, and it washes except a protective coat formation field. Then, a protective coat 12 is removed.
[0012] Drawing 26 shows other examples of the conventional technique. With this conventional technique, gases, such as nitrogen, are supplied to a wafer front-face side, placing the front face of a wafer 10 upside down, rotating a wafer, and supplying an etching reagent FPM to a wafer side side. Protecting a wafer front face with gases, such as nitrogen, FPM which turns to an end face is controlled and a wafer side and the circumference of wafer surface are washed.
[0013]
[Problem(s) to be Solved by the Invention] The conventional technique of drawing 25 becomes indispensable [not giving a damage to the semiconductor device wiring material which the device which does not make a protective coat form around surface is needed, and is formed in the wafer front face in removal of a protective coat] in membrane formation of a wafer surface protective coat. When processing a resist as a protective coat, it is difficult to remove a protective coat, without the problem that a routing counter increases arising and giving a damage to a wiring material etc.
[0014] The conventional technique of drawing 26 is controlling the surroundings lump of FPM to a wafer end face by the wafer rotational frequency and the flow rate of gases, such as nitrogen which supplies a wafer front-face side, and the control is difficult. The part to which a penetrant remover touches a gas lenticulates along with a wafer periphery on a wafer front face (inferior surface of tongue), in a certain part, a penetrant remover reaches to a device formation field, a device forming face may be corroded or a metal membrane [**** / un-] may remain [a wafer surface boundary region cannot be washed in a certain part, and]. Therefore, it cannot be used when a surrounding distance outside a device formation field is small like 1.5-2.0mm.
[0015] The purpose of this invention is to offer the etching removal approach and equipment which solved the problem of the above conventional techniques, and the washing approach and equipment.
[0016]
[Means for Solving the Problem] The etching stripper and washing station of this invention are equipped with a means to hold and rotate a wafer, one rear-face nozzle which spouts a liquid in the center of a wafer side, and one surface nozzle which spouts a liquid in the center of a wafer front face.
[0017] From an edge nozzle and a rear-face nozzle, an etching reagent or a penetrant remover is supplied according to the application of etching removal or washing. Moreover, from a surface nozzle, the liquid for protecting a wafer front face is supplied.
[0018] the equipment of this invention -- especially -- DAMASHIN -- when forming Cu wiring by law, after being formed in a wafer periphery of the leakage of Cu plating liquid, and removing Plating Cu and carrying out chemical machinery polish of the plating Cu, it is suitable for especially washing the contamination Cu adhering to a wafer periphery and a rear face.
[0019] Especially, since a liquid is made to blow off in the shape of a beam, it becomes possible from an edge nozzle to remove or wash a metal membrane [**** / the circumference of surface / un-], and a contamination metal with a sufficient controllability.
[0020] Moreover, since pure water etc. was supplied to the wafer front face from the surface nozzle and the wafer front face is protected, a wiring material etc. does not receive a damage.
[0021] In the case of an etching stripper, when the metal membrane which should be removed exists only on the outskirts of surface of a wafer, a rear-face nozzle can also be excluded.
[0022]
[Embodiment of the Invention] Drawing 1 is drawing showing the fitting location of the nozzle in the gestalt of 1 operation of the etching stripper of this invention, and a washing station. Since an etching stripper and a washing station are the same structures fundamentally, they are explained by the following explanation, without distinguishing these.
[0023] The gestalt of this operation shows the example which formed the surface nozzle 14, the rear-face nozzle 16, and the edge nozzle 18. The top view and drawing 1 (B) which looked at drawing 1 (A) from the front face of a wafer 10 are a side elevation.
[0024] the surface nozzle 14 -- in the rear-face nozzle 16, an edge nozzle spouts a liquid in the center of a wafer side in the center of a wafer front face around wafer surface.
[0025] Although it depended for whenever [attaching position / of these nozzles /, and champing-angle] on wafer size, 150mm, 200mm, and 300mm wafer were planned, and the location and the include angle were set up.
[0026] As an example, it is the height H1 from the wafer front face of the surface nozzle 14. It is 10-100mm and could be 50mm in this example. Moreover, height H2 from the wafer side of the rear-face nozzle 16 It is 10-100mm

and could be 50mm in this example. Moreover, height H3 from the wafer front face of the edge nozzle 18 It is 5-50mm and could be 10mm in this example.
[0027] Distance L1 from the tip of the surface nozzle 14 to the center of a wafer front face It is 70-200mm and could be 120mm in this example. Moreover, distance L2 from the tip of the rear-face nozzle 16 to the center of a wafer side It is 70-200mm and could be 120mm in this example. Moreover, distance L3 from the tip of the edge nozzle 18 to the point that a nozzle center line crosses a wafer front face It is 1-50mm and could be 10mm in this example.
[0028] Include angle theta 1 which looks at from the wafer side face of drawing 1 (B), and the surface nozzle 14 makes with a wafer front face It is 15-60 degrees and could be 45 degrees in this example. Moreover, include angle theta 2 which the rear-face nozzle 16 makes with a wafer front face It is 15-60 degrees and could be 45 degrees in this example. Moreover, include angle theta 3 which the edge nozzle 18 makes with a wafer front face It is 10-50 degrees and could be 35 degrees in this example.
[0029] Include angle theta 4 made with the tangent 20 of a wafer hand of cut in the point that see the wafer front face of drawing 1 (A) from a top, and the center line of the edge nozzle 18 crosses the circumference of wafer surface It is 0-90 degrees and could be 45 degrees in this example. Namely, what is necessary is just to be able to spout so that the liquid which blew off from the edge nozzle 18 may not flow in in the direction of the inside from a wafer surface periphery.
[0030] in addition, making a liquid blow off in the shape of a beam, or making a liquid blow off in the state of spraying, since the liquid which blew off from the surface nozzle 14 and the rear-face nozzle 16 can be opened toward the wafer circumference with the centrifugal force by rotation of a wafer and the jet condition of the liquid of the surface nozzle 14 and the rear-face nozzle 16 should just supply a liquid in the center of a wafer -- you may be any.
[0031] On the other hand, since it is required that a liquid should be contacted with a controllability sufficient to the circumference of wafer surface, the edge nozzle 18 is the thing of the structure of making a liquid blowing off in the shape of [whose a diameter is 0.5-2.0mm] a beam, or a thing of structure made to blow off to a flabellate form along with the wafer periphery section.
[0032] In the above example, although the edge nozzle was explained as one piece, it cannot restrict to one piece and two or more pieces can also be prepared.
[0033] Drawing 2 is drawing showing an example of a wafer maintenance device in the gestalt of this operation. (A) is an abbreviation perspective view and (B) is a side elevation.
[0034] This wafer maintenance device is a maintenance device of a roller chuck method, and has four wafer rollers 22 with which each was connected with the revolving shaft 24. The slot 26 which supports a wafer 10 is formed in the perimeter side face of a wafer roller, and a wafer 10 is supported by these slots, and when the wafer roller 22 rotates, it has structure which a wafer rotates.
[0035] Although the number of a wafer roller was four pieces in this example, it may not restrict to this, and as long as it is the number within the limits of 3-8 pieces, you may be what kind of the number.
[0036] Since the end face of the same part of a wafer is not always supported by the wafer roller, it is suitable for the wafer maintenance device of this roller chuck method to process the end face of a wafer perimeter enclosure for using for the etching removal approach and the washing approach of this invention which are demanded. Since the location of the wafer roller 22 and a revolving shaft 24 is being fixed, the liquid which blew off from the rear-face nozzle 16 is not interrupted with a revolving shaft 24, and a liquid can be contacted there is no futility in a wafer side and good.
[0037] Drawing 3 is drawing showing other examples of a wafer maintenance device. (A) is an abbreviation perspective view and (B) is a side elevation.
[0038] This wafer maintenance device is the maintenance machine of a pin chuck method, and the level difference which was connected with the rotation base 28 and which supports a wafer is prepared, and it has the pin 30 whose number is four.
[0039] A wafer 10 is supported on the level difference of a pin 30, and has structure which the rotation base 28 rotates.
[0040] Although the number of a pin was four pieces in this example, it may not restrict to this, and may be good also as 3-8 pieces, and you may be what kind of the number.
[0041] In order that the wafer maintenance device of this pin chuck method may avoid that a pin always supports the same part of a wafer end face, during processing, a little maintenance device of a pin chuck is loosened, it is reducing a wafer rotational frequency and the maintenance location of a wafer shifts by inertia only for a moment. The chuck location of a wafer changes according to this wafer **** substitute device.
[0042] Or rotation of a wafer may be suspended, a wafer may be lifted by a handler etc., and a chuck location may be changed.
[0043] Or after establishing the wafer maintenance device whose number is two in which the locations of a chuck differ by the idle state and completing processing by the 1st wafer maintenance device, moving to the 2nd wafer maintenance device can also change a chuck location.
[0044] Drawing 4 is drawing showing the example of further others of a wafer maintenance device. (A) is an

ıbbreviation perspective view and (B) is a side elevation.
0045] Although this wafer maintenance device is the maintenance machine of a pin chuck method like drawing 3 , a wafer has and the substitute means differs from drawing 3 .
0046] This wafer maintenance device can change the pin contact section to a wafer end face by arranging four pins a and four pins b by turns, supporting a wafer 10 by Pin a the first half of processing, and supporting a wafer 10 by Pin b the second half of processing.
0047] In this example, the grand total of the number of a pin can also make three pieces at a time ** and Pins a and b whose number is eight, respectively.
0048] As mentioned above, although three examples of a wafer maintenance device were explained, the concomitant use method of a roller chuck method and a pin chuck method is also possible. In this case, a wafer **** substitute means which was explained by drawing 3 and drawing 4 is unnecessary, when it has a wafer again, it releases a pin chuck in the pin chuck device itself, rotates a wafer to it with a wafer roller, and should be made just to carry out the pin chuck of the different location from a front to it.
[0049] The structure of the etching stripper of a semiconductor device and a washing station was explained above.
[0050] Hereafter, any equipment explained in drawing 1 - drawing 4 can be used for the etching stripper and washing station which use it although the example of the etching removal approach of this invention and the washing approach is explained about the case where Cu wiring is formed.
[0051]
[Example 1] Drawing 5 shows the process flow of an example 1. Drawing 6 - drawing 11 show the sectional view of the edge part of a wafer including a part of device formation field in each process.
[0052] Hereafter, it explains in order of each process.
[0053] (1) As shown in wiring gutter formation drawing 6 , on the device formation field on the Si substrate 32 which constitutes a wafer, form an oxide film (SiO2) 34 and form a wiring gutter 36. In this example, distance of the wafer surface periphery from the edge of a device formation field to a wafer end face is set to about 5mm.
[0054] (2) As shown in the Bahia metal and seed Cu membrane formation drawing 7 , carry out spatter membrane formation of the barrier metal (for example, Ta, TaN, etc.) 38 for preventing diffusion of Cu, and carry out spatter membrane formation of the seed Cu40 continuously. When carrying out spatter membrane formation of the barrier metal 38 or the seed Cu40, a wafer surface periphery is covered with the shield ring, and these spatter film is made not not to be formed here.
[0055] (3) Prepare an O ring, although it does not illustrate as shown in plating Cu membrane formation drawing 8 , pour in plating liquid into an O ring, and form plating Cu42 by electrolytic plating. At this time, as the conventional technique explained, plating Cu44 grows up [plating liquid] to be the exterior of an O ring on leakage and an oxide film 34. It is easy to remove this plating Cu44, and since it causes the Rhine contamination, it must be removed.
[0056] (4) Hold a wafer at the process [**** / un-] of etching ****** of Plating Cu in the wafer maintenance device of an etching stripper which this invention mentioned above.
[0057] From the surface nozzle 14, it blows off and the solution which does not etch Cu, for example, pure water, and organic-acid water solutions (0.001% - 5% of oxalic acid, a citric acid, malonic acid, etc.) are supplied to the center section on the front face of a wafer. Pure water shall be supplied in this example.
[0058] Although Cu is etched into coincidence from the edge nozzle 18, it is SiO2 of a substrate. Cu/SiO2 which cannot carry out an edge easily It blows off and the large solution of a selection ratio is supplied on the outskirts of surface of a wafer.
[0059] As a solution which etches Cu, it is H2 O2. The included acid or alkali solution is desirable. For example, FPM (HF/H2 O2 / H2 O), SPM (H2 SO4/H2 O2/H2 O), There are HPM (HCl/H2 O2 / H2 O), nitric-acid hydrogen peroxide solution (HNO3 / H2 O2 / H2 O), APM (NH4 OH/H2 O2 / H2 O), concentrated nitric acid, etc.
[0060] It sets in these solutions and is Cu/SiO2. The presentation with large etch selectivity is as follows.
[0061] HF:H 2O2 : H2 O=1-10:1-20:100H2 SO4/H2 O2/H2 O=1-10:1-20:100 HCl/H2 O2/H2 O=1-10:1-20:100HNO3/H2 O2 /H2 O=1-10:1-20:100NH4 OH/H2 O2/H2 O=1 - 10:1 to 20:100 concentrated nitric acid (30% - 80%)
To drawing 12 , it is Cu/SiO2 as an example. The FPM presentation ratio dependency of etch selectivity is shown. According to drawing 12 , it is Cu/SiO2. It turns out [about 250 and] by the presentation ratio 1:10:100 that a selection ratio is the largest.
[0062] In this example, FPM shall be used as a solution supplied from an edge nozzle.
[0063] FPM is spouted for pure water from the edge nozzle 18 from the surface nozzle 14, rotating a wafer in an etching stripper.
[0064] Since the pure water which blew off from the surface nozzle 14, and FPM which blew off from the edge nozzle 18 flow toward a wafer periphery according to the centrifugal force by rotation of a wafer, it is prevented that FPM flows in toward the center of a wafer. Moreover, since the device formation field on the front face of a wafer is covered with pure water, even when the rebound phenomenon of FPM by wafer rotation occurs, it can protect the

wafer front face of a device formation field. Therefore, the damage to plating Cu42 and the oxide film 34 which are formed in the wafer front face is avoidable.

[0065] Moreover, from the edge nozzle 18, since the location where FPM contacts a wafer since FPM becomes beam-like and blows off can be adjusted correctly, the plating [**** / un-] Cu44 can improve [a controllability] etching removal. The condition that the plating [**** / un-] Cu44 was removed is shown in drawing 9 .

[0066] (5) Perform Cu annealing annealing and improve the membraneous quality of plating Cu42.

[0067] (6) Go Cu-CMP chemical machinery polish to the front face of an oxide film 34, remove plating Cu42, seed Cu40, and the barrier metal 38, and as shown in drawing 10 , form the Cu wiring 46. Cu which is polish waste adheres to the circumference of surface of the wafer of a silicon substrate 32, an end face, and a rear face by CMP.

[0068] (7) Hold a wafer at the process of ****** of Contamination Cu in the wafer maintenance device of the washing station which this invention mentioned above.

[0069] Pure water is blown off from the surface nozzle 14, and the center section on the front face of a wafer is supplied. To coincidence, FPM is spouted from the edge nozzle 18 and the rear-face nozzle 16. FPM which blew off from the pure water which blew off from the surface nozzle 14, the edge nozzle 18, and the rear-face nozzle 16 flows toward a wafer end face by rotation of a wafer. Without giving these a damage, since plating Cu42 and the oxide film 34 of a device formation field are protected with pure water at this time, it dissolves in FPM and the contamination Cu adhering to the circumference of surface of a wafer, an end face, and a rear face is removed from Si substrate front face. That is, it is washed. Drawing 11 shows the condition that Contamination Cu was removed, by the above washing processing.

[0070] As a penetrant remover, it is H2 O2 with the sufficient removal nature of Contamination Cu like an etching reagent in addition to FPM. The included acid or alkali solution is desirable. For example, there are SPM (H2 SO4/H2 O2/H2 O), HPM (HCl/H2 O2 / H2 O), nitric-acid hydrogen peroxide solution (HNO3 / H2 O2 / H2 O), APM (NH4 OH/H2 O2 / H2 O), concentrated nitric acid, etc.

[0071] Moreover, the liquid for the protection supplied from the surface nozzle 14 can also consider as the organic-acid water solution which does not dissolve Cu besides pure water (0.001% - 5% of oxalic acid, a citric acid, malonic acid, etc.).

[0072]

[Example 2] An example 2 is the case where Cu wiring is formed where a device formation field is further brought close to a wafer end face rather than an example 1, in order to enlarge an effective device formation field. The process flow is the same as the flow shown in drawing 5 . Drawing 13 - drawing 18 show the sectional view of the edge part of a wafer including a part of device formation field in each process.

[0073] Hereafter, it explains in order of each process.

[0074] (1) As shown in wiring gutter formation drawing 13 , on the device formation field on the Si substrate 32 which constitutes a wafer, form an oxide film (SiO2) 34 and form a wiring gutter 36. In this example, distance from the edge of a device formation field to a wafer end face is set to about 2mm.

[0075] (2) As shown in the Bahia metal and seed Cu membrane formation drawing 14 , carry out spatter membrane formation of the barrier metal (for example, Ta, TaN, etc.) 38 for preventing diffusion of Cu, and carry out spatter membrane formation of the seed Cu40 continuously. In this case, it differs in an example 1, and a spatter can be carried out without the shield ring, or membranes can be formed to a wafer side boundary region by carrying out a spatter in the installation base of a diameter [a little] smaller than the diameter of a wafer. Since the distance from the edge of a device formation field to a wafer end face is very short as mentioned above, from the circumference of surface of a wafer, seed Cu40 turns even around a rear face, and is formed by the end-face pan. Since such seed Cu is spread to a device field at a next heating process, and has a bad influence and causes cross contamination, he must be removed.

[0076] (3) Prepare an O ring, although it does not illustrate as shown in plating Cu membrane formation drawing 15 , pour in plating liquid into an O ring, and form plating Cu42 by electrolytic plating. At this time, plating Cu44 grows [plating liquid] on leakage and seed Cu40. Since cross contamination is produced, such plating Cu must be removed.

[0077] (4) Hold a wafer in the wafer maintenance device of an etching stripper which this invention mentioned above at the process [**** / un-] of etching ****** of Seed Cu and Plating Cu. Rotating a wafer, pure water is blown off from the surface nozzle 14, and the center section on the front face of a wafer is supplied. FPM is supplied on the outskirts of surface of a wafer from the edge nozzle 18, FPM is supplied in the center of a wafer side for FPM from the rear-face nozzle 16 at coincidence, and etching removal of the seed Cu40 and plating Cu44 around the circumference of surface of a wafer, an end face, and a rear face is carried out. The condition of having been removed is shown in drawing 16 .

[0078] (5) Perform Cu annealing annealing and improve the membraneous quality of plating Cu42.

[0079] (6) Go Cu-CMP chemical machinery polish to the front face of an oxide film 34, remove plating Cu42, seed Cu40, and the barrier metal 38, and as shown in drawing 17 , form the Cu wiring 46. Cu48 which is polish waste

idheres to the circumference of surface of the wafer of a silicon substrate 32, an end face, and a rear face by CMP.
0080] (7) Hold a wafer at the process of ****** of Contamination Cu in the wafer maintenance device of the washing station which this invention mentioned above.
0081] Pure water is blown off from the surface nozzle 14, and the center section on the front face of a wafer is supplied. Here, when spouting pure water, it is desirable to pass an organic acid temporarily and to wash the contamination Cu adhering to the front face of a device formation field. To coincidence, FPM is spouted from the edge nozzle 18 and the rear-face nozzle 16. FPM which blew off from the pure water, the edge nozzle 18, and the rear-face nozzle 16 which blew off from the surface nozzle 14 flows toward a wafer end face by rotation of a wafer.
0082] It dissolves in FPM and the contamination Cu48 adhering to the circumference of surface of a wafer, an end face, and a rear face is removed from Si substrate front face. That is, it is washed. Drawing 18 shows the condition that Contamination Cu was removed, by the above washing processing. In addition, as usual, at another process, the wafer after CMP may be immersed in a penetrant remover, may wash the whole wafer, and may carry out brush washing.
[0083]
[Example 3] An example 3 is the case where barrier metal turned to the end face and is formed in it from the circumference of surface of a wafer on the occasion of spatter membrane formation of barrier metal, in an example 2. The process flow is the same as the flow shown in drawing 5 . Drawing 19 - drawing 24 show the sectional view of the edge part of a wafer including a part of device formation field in each process.
[0084] Hereafter, it explains in order of each process.
[0085] (1) As shown in wiring gutter formation drawing 19 , on the device formation field on the Si substrate 32 which constitutes a wafer, form an oxide film (SiO2) 34 and form a wiring gutter 36.
[0086] (2) As shown in the Bahia metal and seed Cu membrane formation drawing 20 , carry out spatter membrane formation of the Ta as a barrier metal 38 for preventing diffusion of Cu, and carry out spatter membrane formation of the seed Cu40 continuously. In this case, from the circumference of surface of a wafer, both the barrier metal 38 and the seed Cu40 turn around a rear face, and are formed by the end face and the pan.
[0087] (3) Prepare an O ring, although it does not illustrate as shown in plating Cu membrane formation drawing 21 , pour in plating liquid into an O ring, and form plating Cu42 by electrolytic plating. At this time, plating Cu44 grows [plating liquid] on leakage and seed Cu40.
[0088] (4) Hold a wafer in the wafer maintenance device of an etching stripper which this invention mentioned above at the process [**** / un-] of etching ****** of Seed Cu and Plating Cu and Ta. Rotating a wafer, pure water is blown off from the surface nozzle 14, and the center section on the front face of a wafer is supplied. FPM is supplied on the outskirts of surface of a wafer from the edge nozzle 18, FPM is supplied in the center of a wafer side for FPM from the rear-face nozzle 16 at coincidence, and etching removal of the Cu around the circumference of surface of a wafer, an end face, and a rear face is carried out.
[0089] Then, HF solution is blown off from the edge nozzle 18 and the rear-face nozzle 16 in pure water, and Ta which is the barrier metal 38 is removed from the surface nozzle 14. The condition that Cu and Ta were removed is shown in drawing 22 .
[0090] (5) Perform Cu annealing annealing and improve the membraneous quality of plating Cu42.
[0091] (6) Go Cu-CMP chemical machinery polish to the front face of an oxide film 34, remove Plating Cu, Seed Cu, and barrier metal, and as shown in drawing 23 , form the Cu wiring 46. Cu48 which is polish waste adheres to the circumference of surface of the wafer of a silicon substrate 32, an end face, and a rear face by CMP.
[0092] (7) Hold a wafer at the process of ****** of Contamination Cu in the wafer maintenance device of the washing station which this invention mentioned above.
[0093] Pure water is blown off from the surface nozzle 14, and the center section on the front face of a wafer is supplied. To coincidence, FPM is spouted from the edge nozzle 18 and the rear-face nozzle 16. FPM which blew off from the pure water, the edge nozzle 18, and the rear-face nozzle 16 which blew off from the surface nozzle 14 flows toward a wafer end face by rotation of a wafer.
[0094] It dissolves in FPM and the contamination Cu adhering to the circumference of surface of a wafer, an end face, and a rear face is removed from Si substrate front face. That is, it is washed. Drawing 24 shows the condition that Contamination Cu was removed, by the above washing processing.
[0095] Although the above explanation explained based on the example which forms Cu wiring on an oxide film, this invention can be applied, when forming metal wiring metallurgy group electrodes, such as Pt, Ir, and IrO, on an insulator layer, or also when forming ferroelectric film, such as BST (titanic-acid stolon CHUMU barium) and PZT (titanic-acid zirconium lead).
[0096]
[Effect of the Invention] Since according to this invention liquid, such as pure water for protecting so that effect of processing liquid may not be received in a wafer center section, is supplied to the front face of a revolving wafer by the nozzle at the same time it supplies processing liquid around surface by the nozzle, processing liquid does not flow

in toward the surface center section of a wafer. Therefore, it becomes possible to remove effectively the metal contamination and the metal membrane which exist in the circumference of surface, end face, and wafer side of a wafer, without giving the damage to a semiconductor device wiring material etc.

[0097] Moreover, since the processing liquid to the circumference of surface of a wafer is supplied as the shape of a beam with a nozzle and it can raise the precision of the contact location of the processing liquid in the wafer circumference, it becomes possible [bringing close to a wafer end face as much as possible, and securing a device formation field].

[Translation done.]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The etching stripper characterized by to have one or more edge nozzles which spout the etching reagent for removing the metal membrane [**** / un-] which exists on the outskirts of wafer surface of an outside [a means hold and rotate a wafer in the equipment which carries out etching removal of the metal membrane / **** / un-/ and the device formation field on a wafer] around wafer surface, and one rear-face nozzle which spouts an etching reagent in the center of a wafer side.
[Claim 2] The direction which spouts an etching reagent from an edge nozzle is an etching stripper according to claim 1 characterized by being suitable outside the hand of cut or wafer tangent of a wafer.
[Claim 3] The distance from the tip of said rear-face nozzle to the center of a wafer front face Are 70-200mm and the medial axis of said rear-face nozzle a wafer front face and the include angle to make The distance to the point that are 15-60 degrees and the medial axis of a nozzle crosses the circumference of wafer surface from the tip of said edge nozzle It is the etching stripper according to claim 1 characterized by what the include angle with the tangent of a wafer hand of cut to make is 0-90 degrees in the point that are 1-50mm, see from the top face of a wafer, and the medial axis of said edge nozzle and the medial axis of said edge nozzle cross the circumference of wafer surface.
[Claim 4] The etching stripper according to claim 1 to 3 characterized by having further a wafer front face in a device formation field, and one surface nozzle which spouts the liquid which does not react in the center of a wafer front face.
[Claim 5] The include angle which the distance from the tip of said surface nozzle to the center of a wafer side is 70-200mm, and the medial axis of said surface nozzle makes with a wafer side is an etching stripper according to claim 4 to which it is characterized by what is been 15-60 degrees.
[Claim 6] Said edge nozzle is an etching stripper according to claim 1 to 5 characterized by spouting an etching reagent in the shape of a beam.
[Claim 7] A means to hold and rotate said wafer is an etching stripper according to claim 1 to 6 characterized by being being what depended on the roller chuck method which has two or more rollers.
[Claim 8] A means to hold and rotate said wafer is an etching stripper according to claim 1 to 6 characterized by the ability to be based on the pin chuck method which has two or more pins, and change the chuck location by the pin during rotation.
[Claim 9] It is the etching stripper according to claim 1 to 6 characterized by basing a means to hold said wafer and to rotate on the pin chuck method which has 2 sets of pins which make two or more pins 1 set, arranging the pin of each class by turns, and being able to switch the wafer maintenance by the pin of one group, and the wafer maintenance by the pin of the group of another side.
[Claim 10] The etching stripper according to claim 1 to 6 characterized by establishing the means which the halt locations of a pin chuck differ mutually, have the 1st and the 2nd means of holding said wafer and rotating, and move to the 2nd means after etching with the 1st means.
[Claim 11] The washing station characterized by to have a means hold and rotate a wafer in the equipment which washes the contamination metal which adhered on the wafer, one or more edge nozzles which spout the penetrant remover for washing the adhering contamination metal around wafer surface, and one rear-face nozzle which spout the penetrant remover for washing the adhering contamination metal in the center of a wafer side.
[Claim 12] The direction which spouts an etching reagent from an etching nozzle is a washing station according to claim 11 characterized by being suitable outside the hand of cut or wafer tangent of a wafer.
[Claim 13] The distance from the tip of said rear-face nozzle to the center of a wafer side Are 70-200mm and the medial axis of said rear-face nozzle a wafer side and the include angle to make The distance to the point that are 15-60 degrees and the medial axis of a nozzle crosses the circumference of wafer surface from the tip of said edge nozzle It is the washing station according to claim 11 characterized by what the include angle with the tangent of a wafer hand of cut to make is 0-90 degrees in the point that are 1-50mm, see from the top face of a wafer, and the medial axis of said edge nozzle and the medial axis of said edge nozzle cross the circumference of wafer surface.

Claim 14] The washing station according to claim 11 or 12 characterized by having further a wafer front face in a evice formation field, and one surface nozzle which spouts the liquid which does not react in the center of a wafer ront face.
Claim 15] The include angle which the distance from the tip of said surface nozzle to the center of a wafer front face s 70-200mm, and the medial axis of said surface nozzle makes with a wafer front face is a washing station according o claim 14 with which it is characterized by what is been 15-60 degrees.
Claim 16] Said edge nozzle is a washing station according to claim 11 to 15 characterized by spouting a penetrant emover in the shape of a beam.
Claim 17] A means to hold and rotate said wafer is a washing station according to claim 11 to 16 characterized by eing what depended on the roller chuck method which has two or more rollers.
Claim 18] A means to hold and rotate said wafer is a washing station according to claim 11 to 16 characterized by he ability to be based on the pin chuck method which has two or more pins, and change the chuck location by the pin luring rotation.
Claim 19] It is the washing station according to claim 11 to 16 characterized by basing a means to hold said wafer nd to rotate on the pin chuck method which has 2 sets of pins which make two or more pins 1 set, arranging the pin f each class by turns, and being able to switch the wafer maintenance by the pin of one group, and the wafer maintenance by the pin of the group of another side.
[Claim 20] The etching removal approach characterized by removing by spouting an etching reagent from an edge nozzle around wafer surface, rotating a wafer for the metal membrane [**** / un-] which exists on the outskirts of surface of the wafer outside a device formation field in the approach of carrying out etching removal of the metal membrane [**** / un-] which exists on a wafer.
[Claim 21] The etching removal approach according to claim 20 characterized by spouting the wafer front face in a device formation field, and the liquid which does not react in the center of a wafer front face from a surface nozzle.
[Claim 22] The etching removal approach characterized by removing by blowing off an etching reagent from an edge nozzle around wafer surface, and spouting an etching reagent in the center of a wafer side from a rear-face nozzle, rotating a wafer for the metal membrane [**** / un-] which exists in the circumference of surface of the wafer outside a device formation field, an end face, and a rear face in the approach of carrying out etching removal of the metal membrane [**** / un-] which exists on a wafer.
[Claim 23] The etching removal approach according to claim 22 characterized by spouting the wafer front face in a device formation field, and the liquid which does not react in the center of a wafer front face from a surface nozzle.
[Claim 24] The direction which spouts an etching reagent from an edge nozzle is the etching removal approach according to claim 20 to 23 characterized by being suitable outside the hand of cut or wafer tangent of a wafer.
[Claim 25] When said metal membrane [**** / un-] is Cu film, said etching reagent is H2 O2. The etching removal approach according to claim 20 to 24 characterized by being the included acid or alkali solution.
[Claim 26] When said metal membrane [**** / un-] is Cu film, said etching reagent FPM (HF/H2 O2 / H2 O), SPM (H2 SO4/H2 O2/H2 O), HPM (HCl/H2 O2 / H2 O), nitric-acid hydrogen peroxide solution (HNO3 / H2 O2 / H2 O), APM (NH4 OH/H2 O2 / H2 O), the etching removal approach according to claim 20 to 24 characterized by being chosen out of the group which consists of concentrated nitric acid.
[Claim 27] The substrate of said Cu film is SiO2. When it is the film, the presentation of said etching HF:H 2O2 : H2 O=1-10:1-20:100H2 SO4/H2 O2/H2 O=1-10:1-20:100 HCl/H2 O2/H2 O=1-10:1-20:100HNO3/H2 O2 /H2 O=1-10:1-20:100NH4 OH/H2 O2/H2 O=1 - 10:1 to 20:100 concentrated nitric acid (30% - 80%)
The etching removal approach according to claim 26 which comes out and is characterized by a certain thing.
[Claim 28] The substrate of said Cu film is SiO2. When it is the film, said presentation of FPM is HF:H 2O2. : The etching removal approach according to claim 26 characterized by being H2 O=1:10:100.
[Claim 29] The liquid spouted from said surface nozzle in order to protect the wafer front face in a device formation field, when said metal membrane [**** / un-] is Cu film is the etching removal approach according to claim 21 to 28 characterized by being pure water or an organic-acid water solution.
[Claim 30] Said organic-acid water solution is the etching removal approach according to claim 29 characterized by being chosen out of the group which consists of 0.001% - 5% of oxalic acid, a citric acid, and a malonic acid.
[Claim 31] It is the etching removal approach according to claim 20 to 24 characterized by said etching reagent being an HF solution when said metal membrane [**** / un-] is Ta film, the TaN film, or tantalum oxide film.
[Claim 32] In the approach of washing the contamination metal which adhered on the wafer, the contamination metal adhering to the circumference of surface of the wafer outside a device formation field, an end face, and a rear face, rotating a wafer Blow off a penetrant remover from an edge nozzle around wafer surface, and a penetrant remover is blown off from a rear-face nozzle in the center of a wafer side. When the penetrant remover which blows off from said edge nozzle rebounds toward the center of a wafer in a contact part with a wafer, in order to protect the wafer front face in a device formation field The washing approach characterized by washing the wafer front face in a device formation field, and the liquid which does not react by spouting in the center of a wafer front face from a surface

nozzle.

[Claim 33] The direction which spouts an etching reagent from an edge nozzle is the washing approach according to claim 32 characterized by being suitable outside the hand of cut or wafer tangent of a wafer.

[Claim 34] When said contamination metal is Cu, said penetrant remover is H2 O2. The washing approach according to claim 32 or 34 characterized by being the included acid or alkali solution.

[Claim 35] When said contamination metal is Cu, said penetrant remover FPM (HF/H2 O2 / H2 O), SPM (H2 SO4/H2 O2/H2 O), HPM (HCl/H2 O2 / H2 O), nitric-acid hydrogen peroxide solution (HNO3 / H2 O2 / H2 O), APM (NH4 OH/H2 O2 / H2 O), the washing approach according to claim 32 or 34 characterized by being chosen out of the group which consists of concentrated nitric acid.

[Claim 36] The liquid spouted from said surface nozzle in order to protect the wafer front face in a device formation field, when said contamination metal is Cu is the washing approach according to claim 32 to 35 characterized by being pure water or an organic-acid water solution.

[Claim 37] Said organic-acid water solution is the washing approach according to claim 36 characterized by being chosen out of the group which consists of 0.001% - 5% of oxalic acid, a citric acid, and a malonic acid.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the fitting location of the nozzle in the gestalt of 1 operation of the etching stripper of this invention, or a washing station.
[Drawing 2] It is drawing showing an example of a wafer maintenance device.
[Drawing 3] It is drawing showing other examples of a wafer maintenance device.
[Drawing 4] It is drawing showing the example of further others of a wafer maintenance device.
[Drawing 5] It is the process flow Fig. of an example.
[Drawing 6] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 7] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 8] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 9] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 10] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 11] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 1.
[Drawing 12] Cu/SiO2 It is drawing showing the FPM presentation ratio dependency of etch selectivity.
[Drawing 13] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 14] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 15] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 16] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 17] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 18] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 2.
[Drawing 19] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 20] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 21] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 22] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 23] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 24] It is the sectional view of the edge part of a wafer including a part of device formation field in each process of an example 3.
[Drawing 25] It is drawing showing an example of the conventional technique.
[Drawing 26] It is drawing showing other examples of the conventional technique.

Description of Notations]
14 Surface Nozzle
16 Rear-Face Nozzle
18 Edge Nozzle
22 Wafer Roller
30 Pin
32 Si Substrate
34 Oxide Film
36 Wiring Gutter
38 Barrier Metal
40 Seed Cu
42 44 Plating Cu
48 Contamination Cu

[Translation done.]

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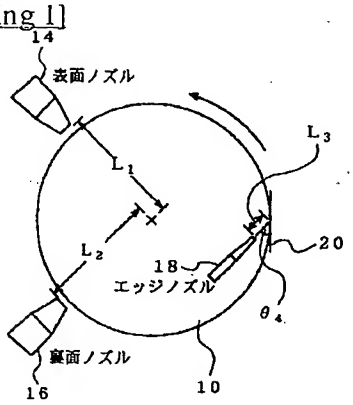
DRAWINGS

[Drawing 1]

(A)



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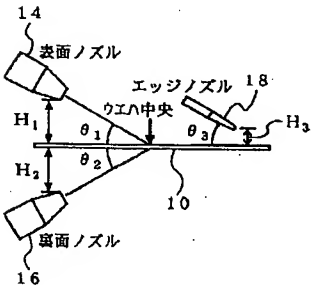
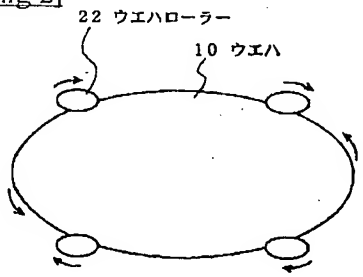


[Drawing 2]

(A)



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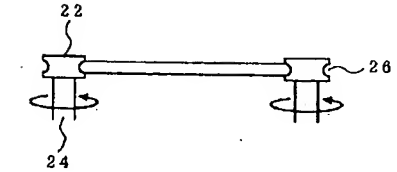

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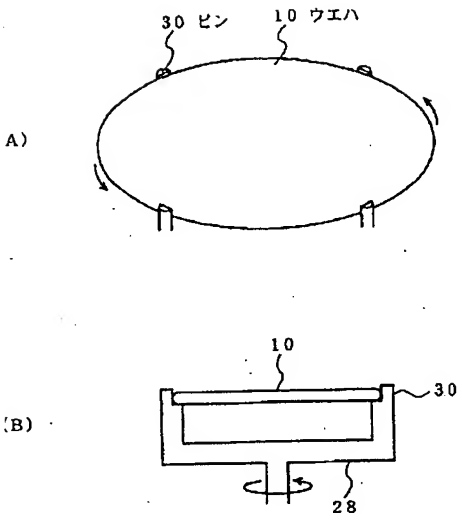
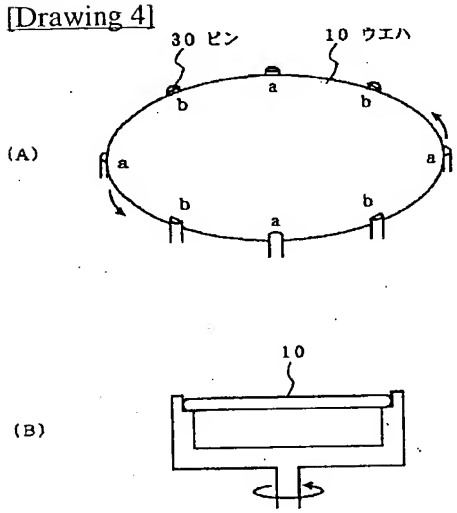
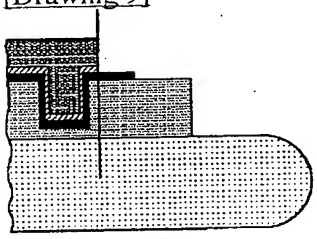


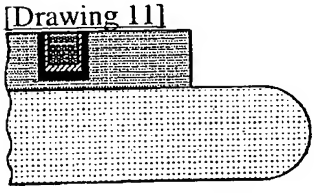
[Drawing 4]



[Drawing 9]



[Drawing 11]



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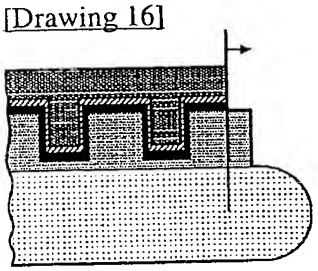
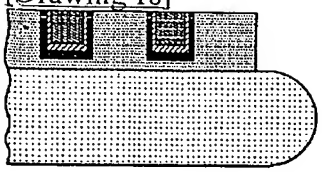
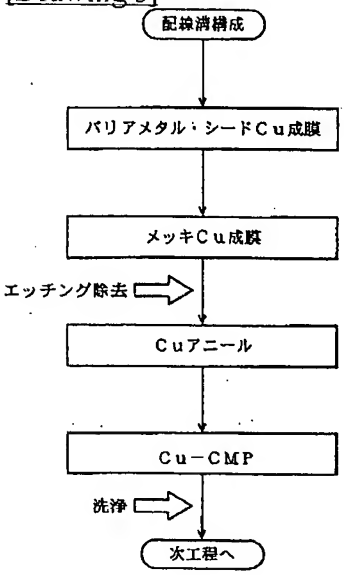


[Drawing 18]



[Drawing 5]



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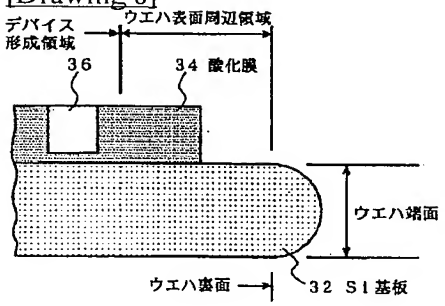

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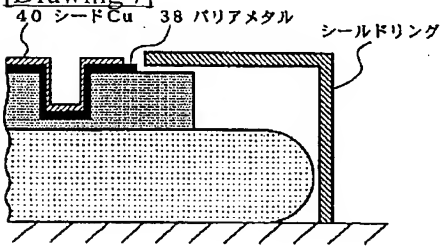

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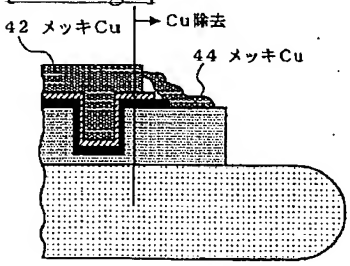
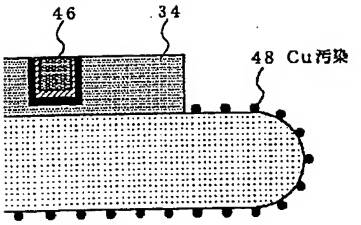
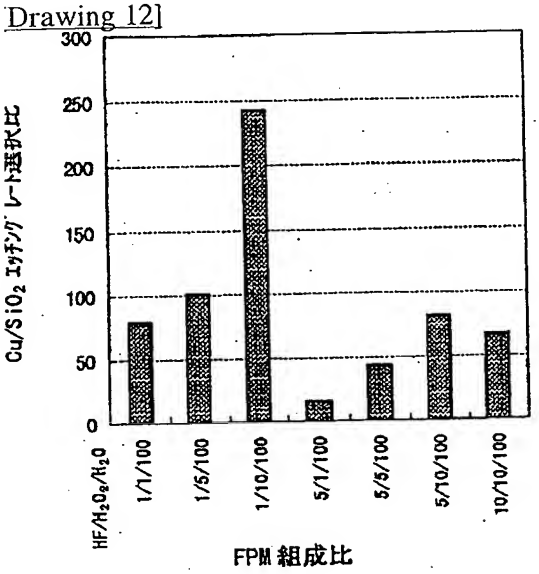


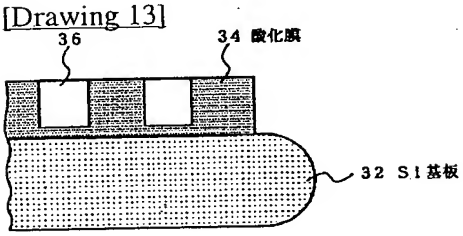
[Drawing 10]



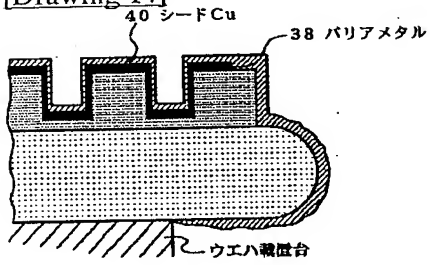
Drawing 12]



[Drawing 13]



[Drawing 14]



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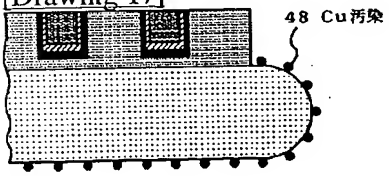

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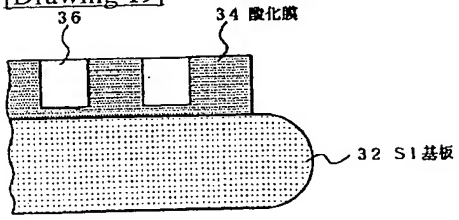

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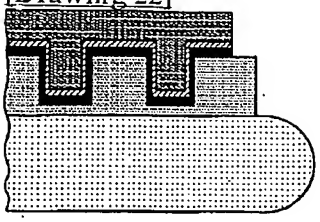

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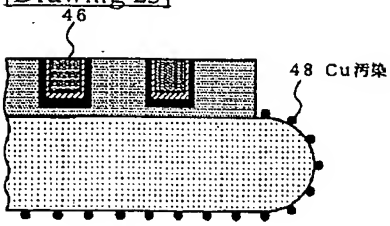
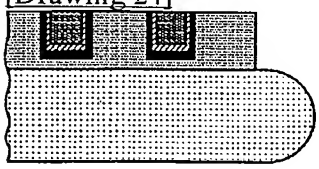


[Drawing 24]



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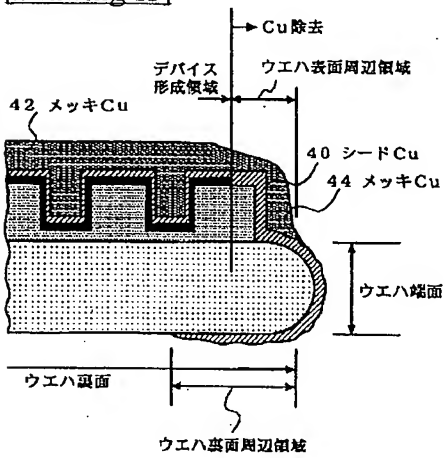
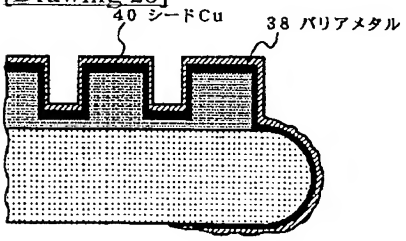


[Drawing 20]



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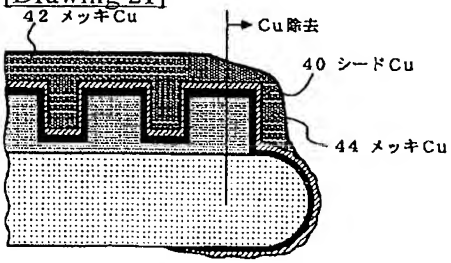

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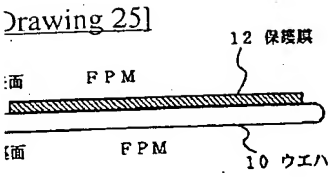
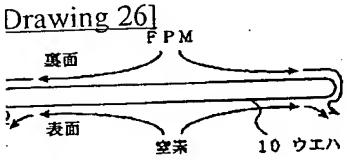


Drawing 26]



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